NEED TO KNOW
a national security newsletter

Volume 2, Number 2 January 2002

# *Engineering Munitions Handling*

## *A U.S. Army Munitions Assessment System*

Looking like astronauts on a Mars mission, three red-suited technicians enter the stainless steel chamber. Hump-backed with back-up oxygen tanks, the men connect to breathing air hoses. Then, with the precision of a surgical team, they begin to work in the compact confines of the chamber.


They raise the first drum with a mechanical lift, open the top, and gently slide out the one of several deadly recovered chemical weapons that they will handle today. These men, members of the U.S. Army Tech Escort Unit (TEU), are tasked to assess, unpack, and repackage recovered chemical munitions.

It was Bob McMorland's job to make sure they could do this dangerous work safely. McMorland, of National Security's Engineered Systems, is the project manager responsible for the design, engineering, prefabrication, assembly, and onsite acceptance testing of the Army's Munitions Assessment System (MAS).

This one-of-a-kind, complex series of vapor confinement and support modules was created by the INEEL to assist the Army with assessment and eventual destruction of non-stockpile recovered chemical warfare materiel, some dating back to World War II.

Engineers in National Security have developed several mobile munitions assessment systems over the past years. TEU uses these truck and trailer or motorhome systems when responding to suspected chemical weapon materiel discoveries. Recently, these INEEL-developed systems were used to confirm that chemical munitions were included among numerous World

See **MUNITIONS**, *page 2*



*In preparation for the final dry run, technicians get some assistance to suit up (top). Each munition is extracted for examination and repacked into individual canisters (above).*

*Technicians place the munition on a specially design dolly to ensure safe movement (above).*


*The Munitions Assessment System is designed for safe handling of recovered chemical weapons (right).*

**MUNITIONS** *(continued from page 1)*

War I relics that surfaced in suburban Washington D.C. But neither the Army nor the INEEL had ever designed a facility-based "production line" assessment system.

## The Process

The MAS is designed to process drums containing multiple chemical munitions. A drum is delivered to the unpack/repackage room via an inlet airlock. Once inside, technicians open the drum and collect any packing material such as Vermiculite or sand, for disposal.

TEU personnel will visually and physically examine each munition. They will seal leaks and decontaminate the casing if necessary and repack each into its own canister. Next, they place the munition into an outlet airlock where the canister is monitored for any external chemical agent contamination

The canister then proceeds to the next stages, X-ray and chemical assessment. The Munitions Assessment System includes several INEEL developed technologies. The digital radiography and computed tomography system will generate detailed X-rays and "CAT scans" of each munition and the portable isotopic neutron spectroscopy system, or PINS, will identify the chemical fill the munition may contain.

Finally, a data package is compiled on each munition before it is returned to a designated igloo to await destruction. For the safety of the soldier and protection of the environment, the Army must be certain of the contents and condition of each munition before it can be destroyed.

The whole process, from start to finish, is monitored by TEU from a remote control room trailer. Within the unpack/pack room, and throughout the assessment process, video cameras scan the technicians as they gently cradle the munitions. Quiet comments and instructions flow back and forth through hands-free voice communications. It is in the control room that the final data assessment package is compiled for each munition.

## System Requirements and Restrictions

McMorland faced some interesting requirements for the MAS – requirements not usually seen even within diverse National Security programs. For example, facility size was restricted by the width of highways and the height of overpasses. This system would be designed and prefabricated at the INEEL, then trucked to and assembled at its final destination. Hence, the series of modules.

Another interesting design restriction was that technicians working in the Munitions Assessment System would be fully encapsulated in personnel protection clothing, including three sets of gloves. All equipment and processes had to be designed to accommodate their bulky and limited movement. Knobs are big, tools are hung at eye level, and edges are smoothed.

McMorland assembled a team of engineers whose variety and number reflected the complexity of the project. Electrical, mechanical, civil, structural, instrumentation and controls, software, HVAC, fire protection and quality assurance engineers all helped design the MAS.

"There are really two big pieces to this project," says McMorland. "The first part is the modules. We've moved munition-handling operations into an engineered controls environment. The second part, equally important, is all of the support systems."

The team designed HVAC, electrical, breathing air, vacuum collection, and personnel decontamination systems to accommodate the heavily garbed technicians and the tasks they will accomplish. Nothing was simple. A dedicated air supply is provided for the four vapor confinement modules with a dedicated exhaust system, including HEPA and carbon filters. Temperature is maintained around 55 degrees, a little cold for office workers but appropriate for the space-suited workers.

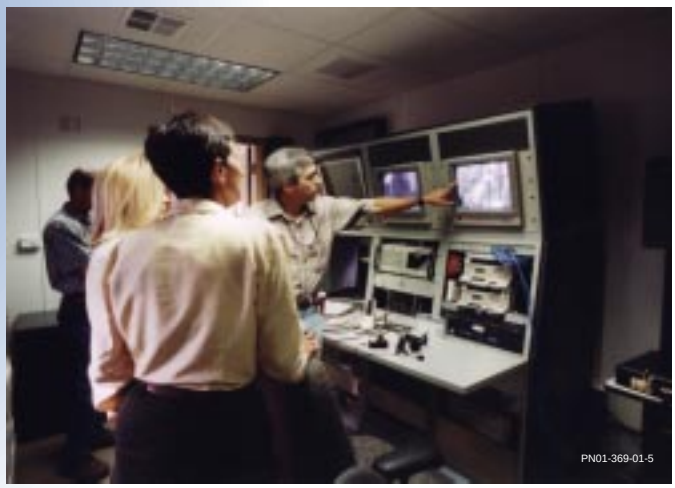
Electrical lines and conduits snake across roofs of the modules and are located there for several reasons – they are out of the way of any decontamination process within the module and are easily accessible for repair or upgrades.

Air monitors continuously sample the atmosphere. Critical



*All equipment and processes within the stainless steel modules were designed to accomodate the limitations of gloved and heavily garbed technicians (above and right).*

*The entire munitions assessment process is monitored from the sophisticated control room. Technicians are watched on video and remain in voice contact at all times.*




## State of the Division

**Laurin Dodd,**
*Associate Laboratory Director, National Security*

The nation now faces challenges that could not have been imagined a few months ago. The phrase 'homeland security' has gone from obscure to commonplace. Secretary Abraham has stated that 'national security' is the mission of the Department of Energy. Overnight, our nation's priorities changed.

Many of the national labs including INEEL, however, were well prepared to contribute to the security of our homeland. Ongoing technology development in support of law enforcement and counter-proliferation are directly applicable to the homeland security mission. Our Critical Infrastructure Initiative, begun in October 2000, is, in fact, a 'homeland security' program. I am gratified that past efforts by staff at INEEL position us support the new and urgent priorities.

INEEL performance during the past year has, for the second consecutive year, received very high ratings from DOE-Idaho. The performance of staff within the National Security Division earned 100% of the fee allocated to national security measures. I congratulate all of you for your efforts in making this possible.

We go into the new year with some significant new resources and responsibilities. The new Material Sciences Support Laboratory and Multi-Purpose Laboratory are fully operational. We have been selected by Bechtel Telecommunications to be its test bed for developing and testing wireless communications technologies and will soon be building the infrastructure to support that effort.

Finally, I am pleased to announce that Bob Summers assumed the position of Director, Defense and Infrastructure Systems. Bob retired as an Air Force Brigadier General in January. His last assignment was as Director for Combat Support at the Defense Threat Reduction Agency. His duties there position him well to provide additional leadership in meeting new national security priorities.

systems, such as breathing air and HVAC, are continuously monitored and alarmed in the control room. Fire suppression systems and a standby power generator stand ready for any emergency.

### *The Human Factor*

It all works. One reason it does is because McMorland and his engineering team involved the operators right from the beginning. They interviewed them and listened to them. The design was built around their needs and wherever possible, included their wants.

"Space was a premium commodity," said McMorland. Restricted by those highways and byways "we had to build full-scale mock-ups. We had to fit in all of the necessary equipment yet still allow maneuverability." In all, INEEL and TEU conducted five walk-throughs, two in the mock-ups alone. In August, when the system was almost complete, the last walk-through took place to fine-tune the design. The only thing missing were real chemical munitions.

The INEEL team size averaged about 12 people, some coming and going, some staying on with the project the whole time. McMorland unequivocally states that it was the contributions of many people that resulted in this quality product. He points out a few: John Becker – vapor confinement module (VCM) fabrication; Paul Mottishaw – VCM welding; Carlos Lopez – munitions handling equipment design and fabrication; Brian Clark – instrumentation, controls, and control room design and fabrication; Fran Hurley – drafting/design drawing coordination; Mona Huffaker – project quality assurance engineer; and Greg Anderson – procurement.

Just because its finished here in Idaho, does not mean the project is done. In January, all of the equipment still at the INEEL will be shipped out. McMorland has staged lots of equipment already. INEEL engineers will start reassembling the modules, which will take about three months. Over the next 18 months, the Army will complete construction, finalize operating procedures, complete safety reviews, and prepare the system for " hot operation". INEEL will manage the onsite acceptance-testing program.

And even that might not be the end. McMorland's team designed the system for flexibility, bolting equipment in place rather than welding it. He recognizes the cost savings potential in using the MAS for other missions. "It will be easy to reconfigure the system to support other chemical warfare materiel projects in the future."

*Technicians carefully load one module onto a trailer in preparation for its journey. The systems were designed to accomodate highway transportation restrictions.*

# *Science Fiction Becomes Science Reality*

Who dreams up James Bond's toys? Who designs the tiny gun hidden in the belt buckle and the explosive disguised as a pen that Q so assiduously describes before each new adventure? Is there a laboratory tucked away where white-coated bespectacled scientists craft new weapons to fight the ever-threatening Spectre?

007 and his gadgets may be a creation of Ian Fleming and Hollywood but those imaginative fellows do exist. A few of them work in INEEL's National Security Division. And there is a government organization that sponsors some of their projects – the Defense Advanced Research Projects Agency.

The Defense Advanced Research Projects Agency, or DARPA is the central research and development organization for the Department of Defense (DoD). It manages and directs selected basic and applied research and development projects for DoD. Its Web site states that it "pursues research and technology where risk and payoff are both very high and where success may provide dramatic advances for traditional military roles and missions."

The agency issues a request for cool ideas in a specific area, and then funds selected proposals. Some pay off, some don't. But the ones that do, pay off big.

National Security's Special Programs conducts DARPA-sponsored research and projects among others. One such project is the Tactical Mobile Robot program and one advanced robot created under this program is called Packbot.


PD02-0002-07

*"We want to prove the technology is robust enough for military or police operations," says Mike Occhionero, team leader for the Tactical Mobile Robot Project.*

## *Tough little robot*

Packbot is a tough little robot developed by iRobot of Summerville, Mass., for DARPA. Small in size, but durable and versatile, Packbot was designed to venture into areas too dangerous for people. The value of robots in real-world situations was recently demonstrated when – after the collapse of the World Trade Centers – Drew Bennent of iRobot helped deploy Packbots supporting search and rescue operations. Packbots went where it was just too dangerous for the human crews.

National Security engineers are designing novel tools for the next generation of the robot. Mike Occhionero leads a team that is developing several 'platforms' and enhancements for the robot to help ensure its survivability. R&D engineers Henry Chu, Ted Reed and David Crandall, and the INEEL Special Response Team, led by Vic Lambson, join National Security team members of Occhionero and Julio Rodriguez. The INEEL has a history of combining its research and operations arms to ensure program success and Rodriguez has been instrumental in coordinating the diverse collaborations.


PD02-0002-05

"TMR (Tactical Mobile Robot) is not yet a mature technology," explains Occhionero. "There are many potential uses and payloads we are looking to demonstrate. We want to prove the technology is capable of being transitioned to full development and is robust enough for military or police operations."


PN01-578-01-10


*Julio Rodriguez manipulates the Packbot's joystick control while monitoring the result on a portable laptop (left). Jon Long, of the INEEL Special Operations Team (prone) and Doug Evanic of Security Operations (seated) align the machine gun prior to mounting it on the robot. This payload is just one of the applications that the TMR project is developing for the mobile robot, christened "Morticia" by team members.*

Occhionero is the right person to lead this INEEL effort. With his military background – he was a pilot – coupled with test and evaluation experience from the Naval Air Warfare Center at China Lake and systems engineering knowledge from the INEEL, Occhionero understands military engineering projects. He was able to show DARPA that the INEEL possessed unique capabilities that enhanced the robot's performance.

He recognized that the eventual users had to be convinced the robot could perform some aspects of a mission and survive when facing an enemy and be convinced of the need to protect the advanced technologies from compromise should the robot be captured. These were specialized niches that didn't exist prior to the INEEL's involvement.

"We had to listen a lot," says Occhionero speaking of hosting TMR's Quarterly Interim Planning Review held this past year in Idaho Falls. During the meeting, over 80 researchers evaluated TMR past program performance, and plotted its future. "We had to find out what the program manager wanted, what other performers were not able or willing to supply and that would become the niche for the INEEL to supply."

## Robot platforms and enhancements

An example is the INEEL armor expertise. From manufacturing armor for the Army's Abrams tanks to developing lightweight armor composites for personnel and vehicle protection, the INEEL knows armor and military armor.

"Getting to work with Henry has been an enlightening experience. He has given me a crash course in armor materials and mechanics that allows us to collaborate on several innovative lightweight armor concepts. TMR is supporting research to manufacture several test articles."

But Occhionero's and Chu's unique approach is not to make a little tank out of Packbot, that would increase its weight and decrease its maneuverability.

"You don't have a choice with a person. You have to protect vulnerable areas. You have to cover them," says Occhionero. "It's different with a robot. We can move things around on the inside." He is talking to Packbot developer iRobot about remaking key components from armor material. The team is developing a concept to "compartmentalize" internal components. The final solution will be a systematic solution combining material, design, and packaging.

The team is also developing a lethal payload. It is equipping the Packbot with a Fabrique National M-249 machine gun and demonstrating its ability to engage targets and to fire remotely.

Another "enhancement" being developed is a self-destruct capability, which may be a better alternative than having the robot fall into enemy hands.

## Field Testing

Right now the robot is equipped with a video camera and the operator can "see" on a computer screen what the robot sees. Occhionero is working with the INEEL special response team to explore its existing capabilities. They are developing scenarios where Packbot could gather intelligence, create a diversion or act as a force multiplier. The INEEL – with its reactor, laboratories, and storage facilities set amidst 890 square miles – is the perfect test site offering actual operating conditions. Development and implementation of tactical scenarios wouldn't be possible without these factors coupled with the security expertise.

Still, with all of these applications on the drawing board, Occhionero and Rodriguez see missing pieces. They would like to work on the communications, command-and-control and the use of multiple robots to perform part or all of a mission

The demonstration robot communicates via wireless Ethernet and the program cannot address communication issues of a fielded system.

They'd also like to work on a command-and-control system that's intuitive; easy for someone to use. Occhionero sees training as a major key to future implementation. Identifying just what skills are needed for a military robotic operator, a combination of technical and tactical or as he describes them "part SWAT team, part computer geek."

DARPA says its mission is to develop imaginative, innovative and often high-risk research ideas that go well beyond the normal evolutionary developmental approaches. National Security's Special Programs is helping. Q would have been proud.

# *Building a Better Mousetrap*

## *Research into advancements for the Portable Isotopic Neutron Spectroscopy System (PINS)*

Used by U.S. Army's Tech Escort and the Defense Threat Reduction Agency (DTRA) around the country and by other organizations around the world, PINS is clearly established as a premier technology in the identification of chemical warfare agents within stockpile and non-stockpile munitions. This recognition has further expanded through its use in environmental applications while confirming contents of abandoned cylinders and long retired operational chemical storage tanks.

Gus Caffrey, developer of the award-winning technology, however, is not content to leave well enough alone. He, funded by the DTRA, is looking for ways to make it work faster, just as reliably, and ship more easily.

Caffrey explains. "PINS uses a small radioactive source, californium $^{252}$, as the neutron source. As effective as it is, shipping radioactive sources carries with it some logistical problems."

The PINS source requires NRC licensing, and air shipment is mostly restricted to cargo planes. While the PINS equipment and technicians can quickly respond to a need at any location, urban or remote, the source must travel separately in conforming to hazardous material shipping rules. Further, radiation safety issues must be carefully monitored through administrative practices and engineering controls. Caffrey believes he can reduce or eliminate these issues while increasing the speed and sensitivity of PINS by replacing the source with a neutron generator.

The advantages are significant. The neutron generator is a radiation source that can be turned on and off with a switch and requires no NRC license. Early test results show it to be just as penetrating as the californium, so PINS can still "see through steel" of up to two inches.

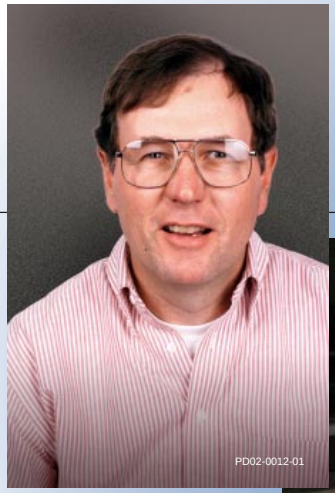
The neutron generator can be operated in a pulse or continuous mode and both offer additional pluses. The pulse mode can increase sensitivity without increasing the radiation in the target, and the continuous mode emits significantly less background, improving the signal-to-noise ratio.

The disadvantages are few and are the focus of the research. The neutron generator, particularly in the pulse mode, requires more complicated electronics – two sections of memory to capture and analyze the data. And the generator itself must be toughened.

"PINS is a field system," says Caffrey. "It's deployed in some harsh environments. We want to design the neutron generator to be rugged, simple and reliable."

In the next months, Caffrey and his colleagues will continue to design and test the next generation of PINS.


*Warning lights reveal when the neutron generator is on.*

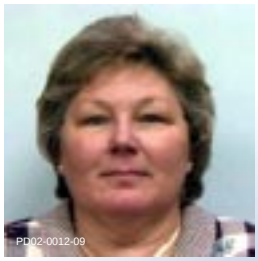




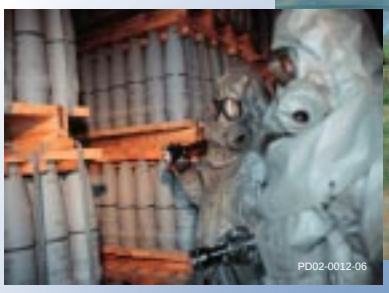


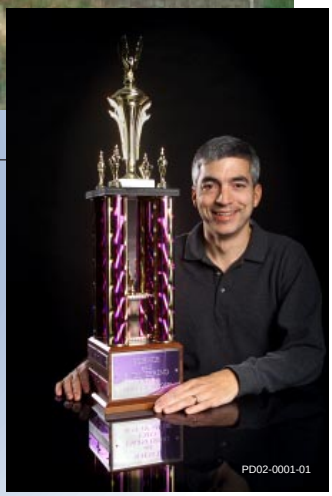
*Physicist Gus Caffrey is looking for ways to make PINS work faster, just as reliably, yet ship more easily (above). Brian Harlow prepares the neutron generator for a series of tests (near right). One of the PINS team's objectives will be to make the generator and its portable control system more rugged (far right above). Safety procedures require an interlock sequence before the generator is turned on (far right below).*

# *Achievements, Accomplishments, and Acknowledgements*







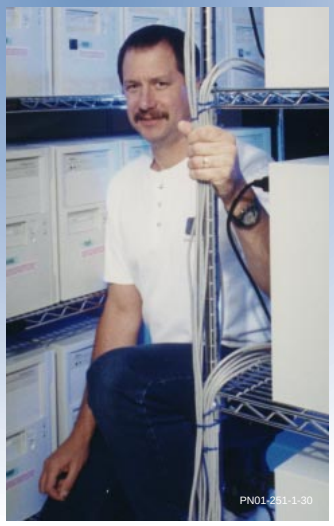




*National Security Division employees highlighted for their achievements include (clockwise from top left) Terri Knudsen, Kevin Young, and Eric Greenwade.*

National Security employee Terri Knudsen's email address isn't the typical @inel.gov. Knudsen doesn't even work in Idaho. Her address domain is army.mil and she works in Pueblo, Colo., as the Chemical Demilitarization manager for the Soldier and Biological Chemical Command (SBCCOM).

Knudsen recently received this significant appointment from the program manager for Pueblo Chemical Depot and approval from Army Headquarters SBCCOM. With it, she is now responsible for establishing a centralized work unit at the Pueblo Chemical Depot (PCD) for the management and coordination of activities related to the Chemical Stockpile Disposal Program and construction and operation of the Pueblo Chemical Disposal Facility. The purpose of the Pueblo Chemical Disposal Facility is to destroy the over 780,000 mustard-filled projectiles stored at PCD.

This role requires expertise in such multidisciplinary areas as chemical, environmental and industrial engineering; knowledge of federal and state laws;




biological/agricultural practices and studies; policies and practices regarding environmental permitting; and extensive knowledge of chemical munitions – life cycle, handling and disposal. Knudsen, who will manage both staff and budget, must also know Army regulations, protocol, processes and operations.

As if that isn't enough, Knudsen is the lead on the Umatilla storage permit, in her words, "the most contentious permit in the SBCCOM system" because of state-specific requirements pertaining to chemical weapon handling and management in an Army storage facility.

Knudsen was originally assigned to PCD in June 2000 under an Intergovernmental Personnel Agreement that is annually renewed with DOE-ID. It is through her unvarying expert execution that she received this appointment. We in the National Security Division congratulate her.

- Eric Greenwade was recently promoted to Fellow, one of only 25 within the INEEL. Greenwade is group leader of the Numerical Simulation Laboratory, a facility incorporating high-performance computing, advanced visualization, high-performance networking, immerse displays, digital video and a variety of UNIX and NT user workstations. He has written 56 publications throughout his career, 48 of which he is the primary author and 32 of which have been invited or peer reviewed. He has enhanced INEEL's contribution and reputation nationally and internationally in the visualization and scientific computing community through technical contributions and leadership positions in many organizations and arenas including: International Silicon Graphics Incorporated/ Cray Users Group, International Sun High Performance Users Group, Accelerated Strategic Computer Initiative, International ISO-15444 JPEG standards working group, Institute of Electrical and Electronics Engineers Visualization, DOE Computer Graphics Forum, and Parallel Tools Consortium. Highlights of a few of Greenwade's projects were included in the July issue of ***Need to Know***. (see *Defining Excellence – Modeling, Simulation and Visualization*, page 6).
- Kevin Young received a Best in Show Trophy for his "Rocket Man" display in the 2001 Science and Engineering Expo. The Idaho Science Teachers Association, in conjunction with the INEEL and DOE hosted the 2001: A Science Odyssey and Exposition. Nearly 1700 students from 89 schools in Idaho, Utah, Wyoming and Washington flocked to the October event.


# The Outsider Threat

Contributed by: Bruce Allbright

*The July issue of the CI Corner addressed the insider threat. This issue looks at the outsider threat.*

Company-to-company attacks launched by economic competitors and foreign intelligence gatherers are the main outsider threats.

According to Jack Way, INEEL Counterintelligence manager, "Outsiders seldom use one method of collection; they combine collection techniques into a concerted effort while becoming more innovative in their approach." Innovative approaches can include using elicitations at national and international conferences, unsolicited e-mail asking for information, searching through trash, presentations funded by a foreign country, job interviewee asking too specific questions, solicitations by friends or acquaintances, or soliciting unwitting employees who don't realize the importance of what they know.

Trends in collecting open-source information can indicate strategic objectives that might resort in illegal collection methods. Once outsiders determine the INEEL has the information they need, the outsiders will do whatever it takes to obtain the desired information. Outsiders try to create a situation where the INEEL employee is induced to give proprietary information, in the mistaken belief that the requester has been properly authorized to receive it.

Targeted technologies, including those developed by the INEEL, represent the culmination of many years of effort and vast economic and/or defense investments for the Laboratory and the United States. As INEEL employees, we must work to ensure that the theft of INEEL or our customers' proprietary information does not occur.


*Outsiders try to create a situation where the INEEL employee is induced to give proprietary information, in the mistaken belief that the requester has been properly authorized to receive it.*

John J. Higgins, Hughes Electronics Corporation senior vice president and general counsel, said, "Our proprietary information is the intellectual currency we need to buy into the future and we must do everything possible to stem its loss."

Remember JDLR (Just Doesn't Look Right). Contact your Counterintelligence Office, 526-2223 or Security Office, 526-0952, if you have any questions or concerns. For more information about espionage and target technologies, check out the INEEL Counterintelligence internal Web page at http://wantnot.inel.gov/ci.

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**Editor** ..... Kathy Gatens
**Graphic artist** .... David Combs
**Photographers** .. Mike Crane, Chris Morgan, Ron Paarmann
**Copy editing** ..... Rick Bolton

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